

Constructing Knowledge in the Twenty-First Century: I-LEARN and Using Information as a Tool for Learning

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To be efficient and effective learners in the information age, individuals must be able to engage successfully with a wide variety of information types and formats. Becoming lifelong learners in a world in which information flows freely and defies the boundaries of traditional disciplines and subject areas, children and youth in particular must develop strategies for engaging with ideas that transcend the curriculum and its usual topics and structures. The I-LEARN Model—Identify, Locate, Evaluate, Apply, Reflect, kNow—describes the process of learning with information and provides school librarians and others with a teaching tool created specifically for information-age learning. A learning model that expands traditional information-seeking models in important ways, I-LEARN assumes that learning itself is the goal of information-seeking in schools and that information in its various representations is the basic building block for lifelong learning in the twenty-first century. Grounded in research and theory from both information science and instructional systems design, and based on the author's own research and writing over more than a decade, I-LEARN builds on the well-known tripartite information literacy paradigm—accessing, evaluating, and using information—to operationalize an inquiry approach to learning.

The I-LEARN model—Identify, Locate, Evaluate, Apply, Reflect, kNow—both describes the process of learning with information and provides school library media specialists and others with a teaching tool linked directly to information-age learning. A *learning* model, I-LEARN expands traditional information-seeking models (e.g., Wilson 1999) in important ways. It also stands on the shoulders of such classics as Eisenberg and Berkowitz's (1990) Big Six Information Processing Skills and Kuhlthau's (1993) Information Search Process provides a way to operationalize the inquiry-learning approach proposed by Kuhlthau, Maniotes, and Caspari (2007).

I-LEARN assumes that learning itself is the goal of information-seeking in schools and that information in its various representations is the basic building block for twenty-first-century learning: the model's "Apply" and "Reflect" stages put the application of information to learning at its center. Whether presented through print, audio, visual, multisensory, or digital media, the information itself is what learners apply and reflect on to make meaning. Grounded in research and theory from both information science and instructional systems design, and based on the author's own research and writing over more than a decade, I-LEARN expands the well-known information literacy paradigm—accessing, evaluating, and using information—to focus specifically on the use of information as a tool for learning (see Neuman 2011).

The model draws heavily on Doyle's (1992) early work in identifying the components of information literacy and on the American Library Association's (ALA) subsequent definition of that phenomenon:

To be information literate, a person must be able to recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information. . . . Ultimately, information literate people are those who have learned how to learn. . . . They are people prepared for lifelong learning because they can always find the information needed for any task or decision at hand. (ALA 1989, 1)

This definition is significant because it makes explicit the link between learning and information use. It suggests going beyond the general notion of information-seeking (accessing and evaluating information) to encompass the ultimate reason for students' information-seeking—that is, learning. The key assumption underlying the I-LEARN model is that "developing expertise in accessing, evaluating, and using information is in fact the authentic learning that modern education seeks to promote" (AASL and AECT 1998, 2).

The I-LEARN Model

As [figure 1](#) shows, the I-LEARN model includes six stages that describe the process of learning with information:

- Identify a problem or question that can be addressed through information.
- Locate information that can be used to address the problem or question at hand.
- Evaluate the information.
- Apply the selected information to the learning task.
- Reflect on both the product and the process of the preceding stages.
- kNow what has been learned so that it resolves the problem or question and so that it can be used to spur future knowledge generation.

Although the model is depicted in a linear fashion for the purposes of clarity and efficient presentation, it is by its nature iterative, offering possibilities for looping within and across each of its stages.

As [table 1](#) shows, the model also includes eighteen elements—three related to each stage—that flesh out those major stages with suggested ways to implement them. It is anticipated that in particular situations in practice, the number of these elements might increase or decrease—and some might even change—according to the needs of students and teachers and the demands of particular learning tasks. The elements listed under “Evaluate,” for example, might include only two of the three, or might focus on comprehensiveness rather than timeliness in the use of information, to learn something about a hot-button political or social issue. In other words, while the stages are stable, the elements should be considered possibilities rather than formulas.

It is significant that the “I” in the initial stage suggests several concepts in addition to “Identify”: the dependence on “information” as the building block for learning is clearly implied, as is the personal responsibility for one’s own learning assumed by constructivism: “I” create my own understanding of the world. Further, it is important to note that the “kNow” stage ends with the element titled “activate”—the same element that begins the learning process under “Identify.” The implication is that greater knowledge about the world is likely to stimulate even more curiosity about its nature, structures, and processes. It also is useful to remember that the grapheme for “kNow”—which ends in “Now”—reinforces the idea that twenty-first-century learning is generally dynamic, rapid, and responsive to immediate situations and needs.

I-LEARN is clearly related to the three basic components of information literacy—access, evaluate, and use (see [figure 2](#)). “Access” is obviously related to “Locate,” although the model encompasses locating information inherent in the environment as well as accessing information in databases and other library resources. “Evaluate” is the same concept in the model as it is in the usual conception of information literacy. I-LEARN’s chief contribution lies in its expansion of the dimension of “Use”: the three culminating stages greatly extend the information literacy idea of “use” by tying it directly to learning. In typical models of information behavior, “use” is generally a vague term describing something beyond the information-seeking process itself. In the I-LEARN model, however, “use” is central: “Apply” describes the process of using information to generate knowledge—that is, to learn; “Reflect” is seen as a key factor in ensuring that learning is personally meaningful; and “kNow” describes how individuals own and employ their knowledge once they have acquired it.

Theoretical and Research Background

Theoretically, the I-LEARN model draws from conceptions of the nature of information presented both in the information science literature (e.g., Buckland 1991; Marchionini 1995; Wilson, 1981,1999) and in the literature of instructional design (e.g., Anderson and Krathwohl 2001; Gagne 1965, 1977, 1985; Hill and Hannafin 2001; Mayer 1999; Merrill 1983,1999). It combines and expands these understandings in a way that suggests that information is a dynamic phenomenon consisting of entities and relationships that can be mixed and matched according to their nature and the uses to which they are put—including learning.

Buckland’s (1991) typology blurs the traditional distinction between information and knowledge and posits that information is more dynamic than such a clear dichotomy suggests. According to Buckland, information can be conceptualized as a process (i.e., the communication act); as knowledge (i.e., an increase in understanding or a reduction in uncertainty); and as thing (i.e., an object that imparts information). Marchionini (1995) builds on Buckland’s ideas to

note that information “is anything that can change a person’s knowledge” and that it “includes objects in the world, what is transferred from people or objects to a person’s cognitive system, and . . . the components of internal knowledge in people’s minds” (5). Both authors, then, affirm the dynamism of information.

Wilson (1981,1999) represents another information-science perspective, and his own model opened the door for information-science investigations into how information is used as well as sought. Extending the concept of information-seeking to include information behavior (i.e., information-seeking embedded in a context) his model broadened the field’s scope to include the study of what might be done with information after it has been found. By including a step labeled “information processing and use,” Wilson became one of the earliest information-science researchers to consider directly the cognitive aspects of interactions with information. Clearly, one of the most important cognitive aspects of such interactions is the act of learning itself.

Gagne (1965,1977,1985) is revered among instructional-design theorists for linking the activities of instruction to the corresponding steps of cognitive information processing (e.g., showing the relationship of activities designed for “stimulating recall” to the step of “coding/storage entry”). Gagne also proposed “categories of learning” that correspond closely to different types of information use, from making simple stimulus–response connections to engaging in highly complex information behavior (from mastering verbal information at one end of the spectrum to engaging in problem solving at the other). Similarly, Merrill (1983,1999) proposed that information to be learned consists of four types (facts, concepts, principles, and procedures) and that learning involves three kinds of cognitive performance (remember, use, and find). Anderson and Krathwohl’s 2001 revision of Bloom’s *Taxonomy of Educational Objectives* updates and encapsulates these long-held ideas about the nature of knowledge and of learning, as does the I-LEARN model (as explained below). Finally, the model is grounded in the understanding of learning summarized in Bransford, Brown, and Cocking (2000) for the National Research Council. These authors’ constructivist view—that learning is an active, dynamic process that involves stages and levels—meshes well with the dynamism of information itself. The I-LEARN model—itsself a dynamic construct—encompasses all these dimensions.

I-LEARN links information behavior directly to the content of learning—specifically, to the four types of knowledge (factual, conceptual, procedural, and metacognitive) and to the six levels of learning (remember, understand, apply, analyze, evaluate, and create) described in Anderson and Krathwohl (2001). For example, as [figure 3](#) shows, “Locating” information involves finding the *factual and conceptual knowledge* that will be the building blocks of learning; “Evaluating” information involves using *metacognitive knowledge* to judge the appropriateness of information; and “Applying,” “Reflecting,” and “kNowing” all involve both *procedural and metacognitive knowledge*—knowledge of how to put facts and concepts together and of what ideas to select and how to arrange them into a coherent whole.

Perhaps even more intriguing is I-LEARN’s relationship to the Anderson and Krathwohl (2001) taxonomy’s levels of learning displayed in [figure 4](#). “Locate” is clearly tied to the levels of *remembering* and *understanding*, since learners must remember and understand the facts and concepts they uncover while looking for information. “Evaluate” encompasses those two levels and also suggests levels of *analyzing* information and *evaluating* its quality. Finally, I-LEARN’s stages of “Applying,” “Reflecting,” and “kNowing” involve those four levels and add the taxonomy’s final two: learners *apply* information to solving problems and answering questions, thereby *creating* new knowledge on the basis of that information. While examining the details of all these interrelationships is neither useful nor even possible, the obviousness of their existence provides yet another tie to the key concept that information is the basic building block for human learning and reinforces I-LEARN’s grounding in learning theory.

The model also encompasses learning with information represented in all types of formats—print; single-sense visual and audio; multimedia, including static and motion media; and digital. While it focuses primarily on the information conveyed through these technologies, in its full explication it accommodates the learning affordances and constraints inherent in each (see Jonassen 2004; Kozma 1991; Smaldino, Lowther, and Russell 2008; Spector et al. 2008). By accommodating what over fifty years of research in instructional design and technology have shown about the details of learning with the full range of information formats, I-LEARN links information-based learning to a rich knowledge base that offers guidelines for designing, presenting, and assessing materials and experiences that support deep and meaningful learning.

The research base for I-LEARN also includes research and writing by the model’s creator over almost two decades (see Neuman 2011). A consistent theme throughout these publications involves how information can be organized and presented to enhance students’ opportunities for deep engagement with content that will enable them to construct higher-level knowledge. Ideas from many other information-science researchers—Bilal 2000, 2001; Crane and Markowitz 1994; Eisenberg and Small,1995; Fidel et al. 1999; Kafai and Bates 1997; Kuhlthau 1997; Large et al. 1994, 1995, 1996; McGregor 1994; and Pitts 1994, to name a few—also have informed the development of the model.

I-LEARN in Practice

In practical terms, I-LEARN provides both a description of the process of learning with information and a strategy that can be taught and used to invoke that process successfully. With its deep grounding in research and theory, its potential as a learning tool seems strong. By “operationalizing” learning with information in six stages and a few elements within each, the model not only offers a clear and succinct way to explain what happens when we use information as the basis for our learning but also suggests a straightforward process that library media specialists and teachers can use to help students master the task of learning in the information age—whether that learning occurs in school or in other venues.

Validating I-LEARN in practice—the next step in its development—will clarify the extent to which its potential can be achieved. Currently, several approaches to validation are under discussion: developing and testing the model both in a university setting and with a school district and recruiting teams of school librarians and teachers nationally to collaborate with the author to identify information-based questions related to various curricular areas and to develop possible scenarios for applying I-LEARN to solve them. The scenarios would then be used to guide students’ research as they seek answers, and students’ experiences would form the basis for revising and refining the scenarios. Ultimately, a collection of scenarios—much like the widely used collection of MapQuests—would be made available.

Figure 5 displays the form such a scenario might take. The six I-LEARN stages form a stable scaffolding, while the elements can vary according to the task at hand. For example, in this scenario one might Evaluate different elements of relevance and timeliness than those listed or Apply the information to generate a landscape design rather than a full plan. Further, both the stages and the elements can support learning either for a school assignment or for an interest beyond the curriculum. If the example related to a school assignment, the elements might be more structured and related to specific standards and outcomes outlined in an ecology curriculum. If it were a personal project, the elements might be more related to the nature of the student’s neighborhood and, for example, its need for a playground rather than a garden. The interplay between the structure of the stages and the inherent flexibility of the elements provides a tool that can be used in a variety of settings, both formal and informal, and that lays the foundation for lifelong learning.

I-LEARN: A Timely Tool for Today’s Learners with Information

At this point in the information age, more and more organizations are coming to understand the critical importance of learning how to learn with information. The American Association of School Librarians and the Association for Educational Communications and Technology led the way with the development of the Information Literacy Standards for Student Learning (ILSSL) for *Information Power: Building Partnerships for Learning* in 1998. Soon, the Association of College and Research Libraries (www.acrl.org) followed suit with a series of documents related to learning with information: *Information Literacy Competencies for Higher Education* (2000), *Information Literacy Standards for Science and Technology* (2006), *Research Competency Guidelines for Literatures in English* (2007), *Information Literacy Standards for Anthropology and Sociology Students* (2008), *Information Literacy Competency Standards for Journalism Students and Professionals* (2011), and *Information Literacy Standards for Teacher Education* (2011).

Other organizations—not necessarily related to the field of library and information science—also have taken up the banner. In 2003, for example, the Educational Testing Service (ETS) adopted the European phrase “information and communication technologies,” or ICTs, and defined “ICT literacy” as “the ability to use digital technology, communication tools, and/or networks appropriately to solve *information* problems in order to function in an *information* society” (11, emphasis added). ETS has since identified what it calls iSkills and now offers an “iSkills Assessment” package along with its other evaluation tools (www.ets.org/iskills/about).

A year later, the Partnership for 21st Century Skills (www.21stcenturyskills.org) published its *Framework for 21st Century Learning* (2004), which includes eleven “core subjects,” four “interdisciplinary themes,” and three sets of skills that support students’ learning across all these subjects and themes—including a set titled “Information, Media and Technology Skills.” In 2007, the International Society for Technology in Education (www.iste.org) added “research and information fluency” as a major category in its revised *Standards for Students*, and AASL threaded information literacy throughout its *Standards for the 21st-Century Learner*. Currently, the *Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects* not only focus on reading “informational text” but note the need for students to be able “to gather, comprehend, evaluate, synthesize, and report on

information and ideas [and] to produce and create a high volume and extensive range of print and nonprint text in media forms old and new” (Common Core State Standards Initiative 2010, 4).

Beyond North American borders, UNESCO (www.unesco.org) mounted an “information and media literacy” initiative in the early 2000s and more recently added an “ICT literacy” initiative to its efforts to improve children’s quality of life throughout the world. In 2009, Microsoft, Intel, and Cisco announced a joint and global “Partners in Education Transformation Project” designed to focus on the assessment of ICT skills and to drive instruction to focus on the information skills that are at the heart of ICT literacy (http://newsroom.cisco.com/dlls/2009/prod_011309.html). Perhaps most notably, President Barak Obama identified October 2009 as “National Information Literacy Month.” Within the field of library and information science, the Information School at the University of Washington continues to conduct and publish research on “the nature and impact of information literacy across audiences and contexts” (http://ischool.uw.edu/research/topics/information_literacy).

All these efforts focus on the importance of using information as a tool for learning—and the I-LEARN model offers the only model (so far) designed specifically to address that importance. It supports higher-level learning in the information age, both theoretically and practically. Theoretically, I-LEARN is grounded in contemporary notions of both instructional/learning theory and information theory and builds on both bases to suggest a new theory—a way to conceptualize learning in an age that requires learners to take personal responsibility for defining their own questions; accepting and (more often) rejecting information to answer those questions; and using that information in both critical and creative ways to engender personal, actualizable knowledge. Its emphasis on *evaluating* information and *applying* it to *generate* this new knowledge places its focus directly on the higher levels in Anderson and Krathwohl’s (2001) revision of Bloom’s *Taxonomy*.

Conclusion

The I-LEARN model bridges the fields of information science and instructional/learning science by drawing on components of each to create a way to think about learning that responds directly to the actualities of a world brimming with information. While this blending of information-seeking and learning has been in the literature for well over a decade, the I-LEARN model is the first to combine them in a construct that is grounded in both theory and research and that also has practical implications. Providing this bridge is the most significant contribution of the model. The bridge both describes the process of learning with information and provides school librarians and other educators with a teaching tool directly linked to information-age learning. It offers strong promise for helping children and youth in particular to develop strategies for engaging with ideas that both exemplify and transcend the curriculum and its usual topics and structures to become lifelong learners.

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Tables and Figures: Constructing Knowledge in the Twenty-First Century

Table 1. The I-LEARN Model

Identify	Choose a problem or question that can be addressed through information
Activate	A sense of curiosity about the world
Scan	The environment for a suitable topic within that world to investigate
Formulate	A problem or question about that topic that can be addressed with information
Locate	Access information, either recorded or in the environment
Focus	On what is to be learned
Find	The information needed for that learning
Extract	The most relevant and salient information for that learning
Evaluate	Judge the quality and relevance of the information found
Authority	Credibility of source and/or author; internal logic; accuracy
Relevance	Topic at hand, level of learning/ depth required, appropriateness
Timeliness	Currency, accessibility
Apply	Use the information for a learning task
Generate	Construct new understanding, personal meaning
Organize	Determine appropriate cognitive structure (e.g., chronological, hierarchical, etc.)
Communicate	Create appropriate product to convey that structure
Reflect	Examine product and process
Analyze	Adequacy of both form and content
Revise	Improve as necessary
Refine	Polish as appropriate
kNow	Instantiate knowledge gained

Internalize	Integrate with previous knowledge
Personalize	Recognize meaning as personal construct
Activate	Draw upon as necessary and/or appropriate

Figure 1. The I-LEARN Model

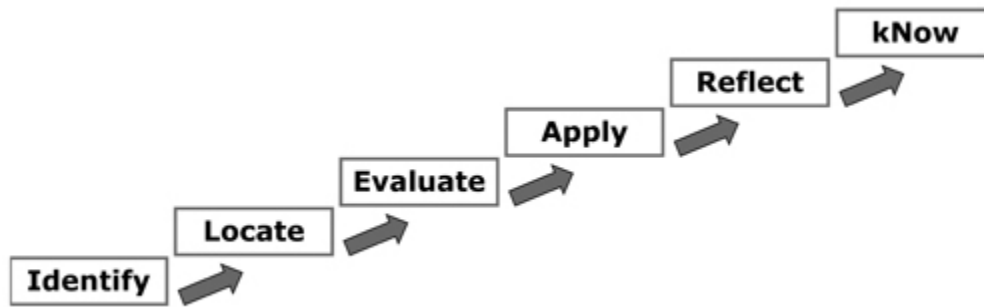


Figure 2. I-LEARN and Information Literacy

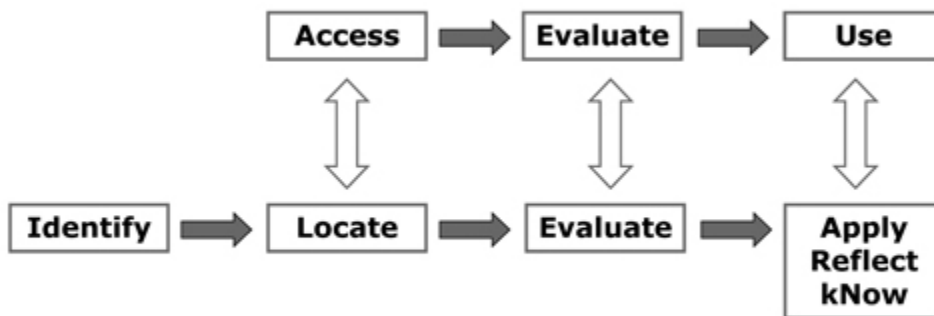


Figure 3. I-LEARN and the Types of Knowledge

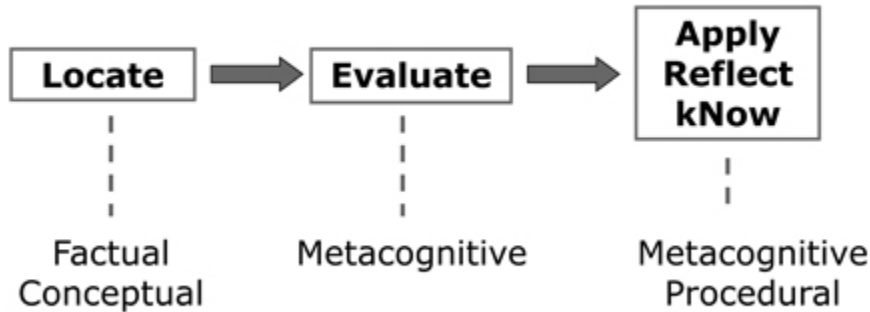


Figure 4. I-LEARN and the Levels of Learning

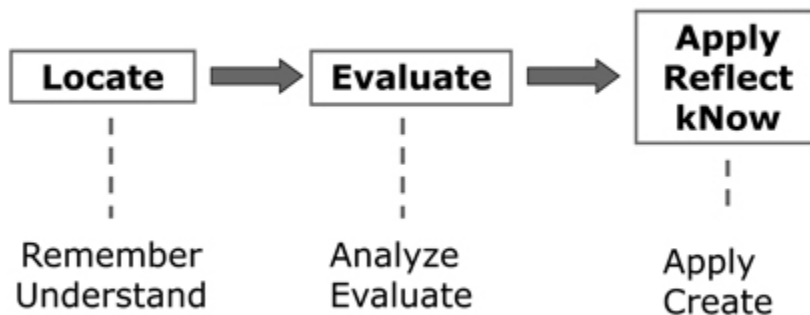


Figure 5. I-LEARN Scenario: Going Green

Identify:

Activate: What can I do to improve my neighborhood?

Scan: There's a vacant lot at the corner that's overrun with weeds.

Formulate: How can I start a neighborhood garden?

Locate:

Focus: What plants grow well in my climate?

Find: Books, databases, websites, radio, and television shows about gardening, information from the local garden store, conversations with friends and neighbors who garden.

Extract: Specific information about what plants—flowers, vegetables, trees, shrubs, etc.—would work in a particular climate zone.

Evaluate:

Authority: Credentials of creator of the information, agreement of information from a variety of sources, etc.

Relevance: What plants or mixture of plants would provide the best garden for *this* neighborhood: flowers, vegetables, a mixture?

Timeliness: Given the season (e.g., fall, early spring), which information will be most useful to me to get this project started?

Apply:

Generate: Create a plan for starting a neighborhood garden.

Organize: Questions for gathering neighborhood input, timeline, photos, design ideas, etc.

Communicate: Survey instrument, print and other publicity, etc.

Reflect:

Review: Is the plan logical, complete, balanced, etc.? Will the survey questions get me the answers I need? Is the publicity attractive and interesting?

Revise: Find more or better information, create better questions and more compelling publicity, etc.

Refine: Finalize the survey and the publicity, revamp the timeline, polish the plan.

kNow:

Internalize: Integrate ideas about planning, seeking approval, gardening, etc., with knowledge gained about similar matters from other experiences.

Personalize: Acknowledge individuality of viewpoint, conclusions, the plan itself.

Activate: Put the plan into action and use it as the basis for planning other projects.

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